

## MANAGING DATA FOR EFFECTIVE RELIABILITY

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*In any capital intensive industry, the desired performance may not have been originally anticipated in system design. Production requirements are challenging performance and reliability of the assets required to produce the product. Whether the product is paper, steel, coal, chocolate bars or electric power - an important step for responsiveness and optimal productivity is to leverage today's proven and available tools for managing asset reliability effectively.*

### **The Situation Today – The Need to Focus on Equipment that is Critical to the Operation**

Assets posing the greatest risk to the business have consequences of failure that affect safety, environmental integrity, output, quality, customer service and operating costs. For example, a utility servicing 5 or 10 or 15 million people over 100,000+ square-miles owns \$5+ billion in physical assets and has hundreds of substations in transmission & distribution, or a paper mill with millions invested in each paper machine – assets that are critical to the operation. These assets need to be reliable and need to perform at optimal levels when in use, especially during peak demand periods. These critical assets need to be the focus of both Maintenance and Operations to optimize reliability and performance, asset utilization and overall equipment efficiency (OEE).

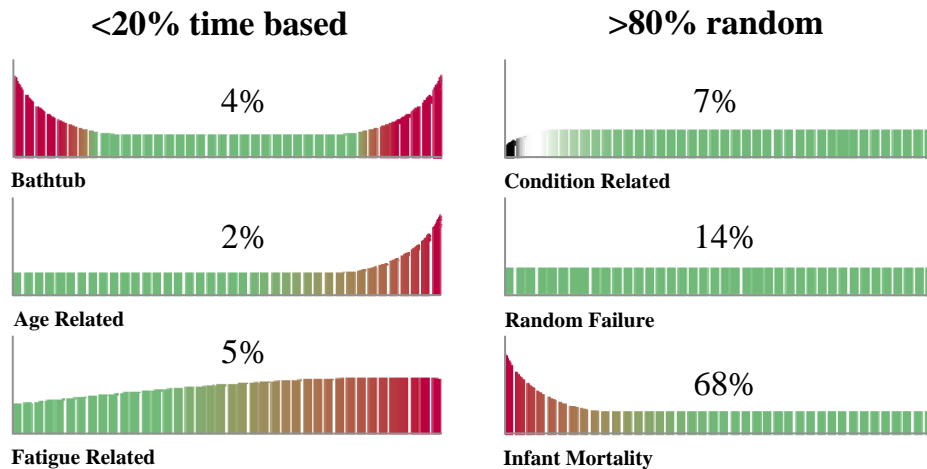
### **Reliability as the Strategy to Improve Asset Performance and Impact Business Goals**

What strategy should be employed to improve performance of critical assets? Current understanding of failure and risk to the business dictates that new approaches are required. Pressure from senior management dictates that the operation is capable – equipment must be available when needed. Management has an understanding of the importance of equipment reliability in meeting company goals and gaining a competitive advantage. Customer retention and responsiveness must be improved. Regulatory standards are mandating higher levels of reliability and proof that companies are complying.

From the operational perspective, asset reliability is the strategy to drive business results. The business case for reliability is clear – the impact of improved asset reliability affects the organization's bottom line.

### **Understanding the Reality of Failure**

Studies originally conducted in 1968, 1973 and 1980 across diverse industries have shown that greater than 80% of all mechanical, electrical and structural failures are random in nature and cannot be effectively correlated to time or run hours.



*The Reality of Failure - Six failure patterns*

To effectively manage these random failures and deliver reliable equipment performance, maintenance organizations must move away from traditional time-based preventive maintenance practices and move toward proactive, condition-based triggers for maintenance actions. To accomplish this, companies are relying more and more on optimizing data-driven predictive maintenance (thermography, vibration, non-destructive testing) and online data collection of equipment health indicators (pressure, temperature, flow, amps, etc.)

These condition-monitoring activities result in massive amounts of data related to the operating health of the equipment. In order to be of any value to maintenance and operations, the data must be effectively analyzed, compared against defined “normal” states and then the results of the analysis must be communicated. Effectively done, this will lead maintenance to do the right work, at the right time.

Accepting these results, traditional time-based preventative maintenance practices are an ineffective way to manage +/- 80% of all mechanical, electrical and/or structural failures. Achieving a high level of effective maintenance and resource-appropriate reliability, organizations must begin to migrate toward proactive, condition-based maintenance practices.

### **The Challenge – Islands of Data**

Many companies have collected condition readings for years, but have lacked the tools to manage and analyze the data properly. The challenge has been the islands of data collected from various sources, including:

- predictive maintenance technologies like vibration and oil analyses, temperature, infrared thermography, the results of which are sitting in databases or spreadsheets
- data historians, SCADA systems, specialized tools that analyze process controls and sensor data

- RCM findings sitting in binders
- paper check sheets from operator rounds and maintenance inspections pile up on desks

These tools often produce masses of data and reports containing merely historical information rather than roadmaps for reliability management.

Condition monitoring is diminished in value if the data is not acted on in a timely manner to trigger the right work at the right time.

Paper checksheets pile up on desks

The challenge is that it has been very difficult to analyze data from multiple sources, correlate and then act on this data in a timely and effective manner. Like most utilities, engineers are manually reviewing this data to determine if any action needs to be taken.

In today's market, software tools are needed to help automate this analysis in order to be more competitive.

In addition, there is a huge amount of undocumented experience and knowledge that exists within the very important, but often overlooked little black books that have existed in maintenance for the past ten to thirty years or held in maintenance experts' heads – this knowledge is almost certainly lost forever when employees retire.

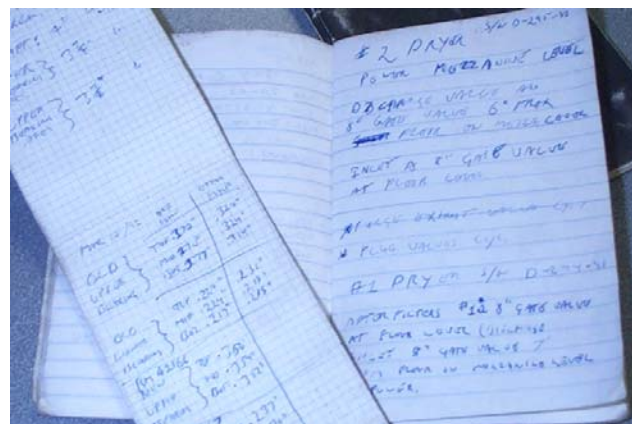


Reliability Engineer manually analyzes condition data

### The Solution

Asset reliability software solves the problem of islands of data.

Leading utility companies are using asset reliability software to consolidate and analyze asset condition data from controls, sensors, data historians, predictive maintenance technologies and visual inspections or other human sensory inspections.



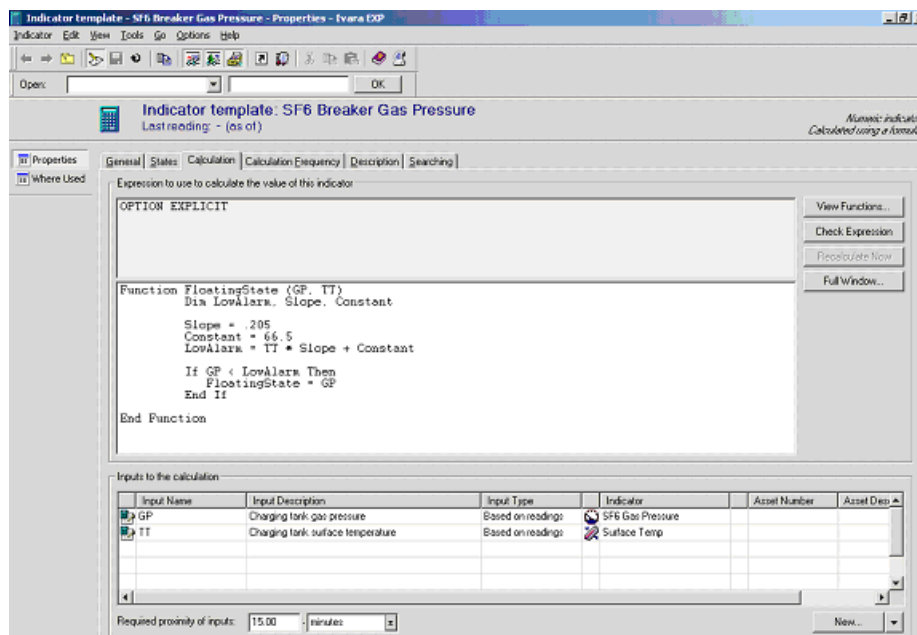
Valuable knowledge stored in little black books

## Performance Analysis Built-In

Engineers no longer need to remember, or spend time repeating, manual calculations and complex algorithms. Software can now perform the calculations and conduct the analysis automatically and present the results visually as flashing alarms, identifying potential failures and recommending corrective actions in a timely fashion.

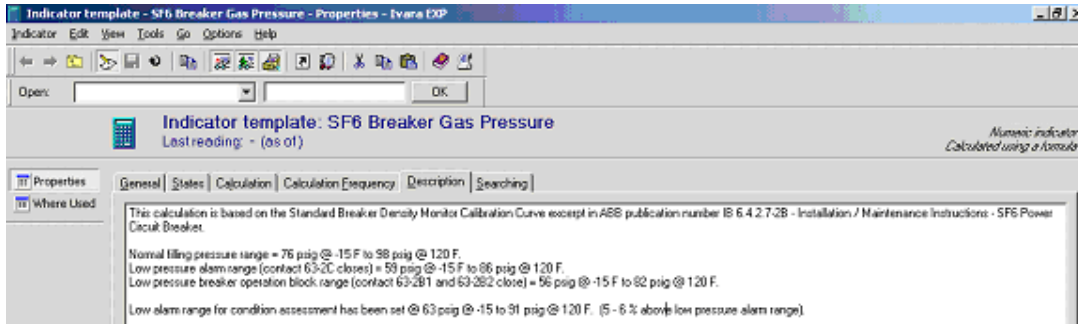
Using multiple data points from various indicators, reliability software analyzes the values of all indicators to determine overall health of the equipment, and identifies the recommended corrective action. The rules it applies can be very sophisticated, incorporating logical expressions, complex equations and engineering calculations. Complex rule-based failure modes become automatic and therefore timely – which is critical, especially where safety and environmental factors are at risk.

For example, below, a standard breaker density monitor calibration curve calculation is built-in to a reliability software system, eliminating the need to manually calculate the slope. Creating a sloped alarm state for this ABB SF6 breakers gas charge, data from daily operator rounds provide valuable input to the calculation.



*Built in calculations save engineers time*

The operator reads the surface temperature of a charging tank, as well as the gas pressure in the tank. The built-in alarm limit floats from 63 psig @ -15 degrees Fahrenheit to 91 psig @ 120 Fahrenheit (5 - 6 % above the circuit breakers low pressure alarm range). If the calculation returns any value above 0, then a low alarm is displayed on an indicator panel. A work order be generated automatically, or the alarm acknowledged by Maintenance and an informed decision made based on the relevant information.

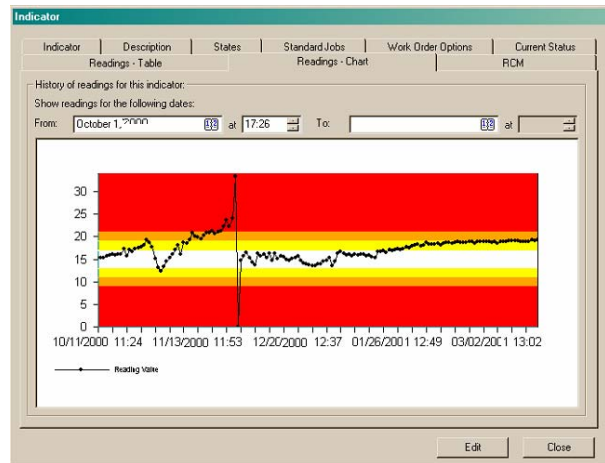


*Rule-based triggers provide timely response to problems*

Utility personnel have lived with islands of data. Now, asset reliability software is able to correlate this data into one information system that automatically initiates the right work at the right time to optimize asset performance and extend asset life.

Charting of asset health indicators allows trends in asset condition to be easily noticed. Bands of color graphically show alarm severity ranges.

This graphing capability dramatically improves the ability to proactively intervene to ensure that asset health is maintained over the long-term.

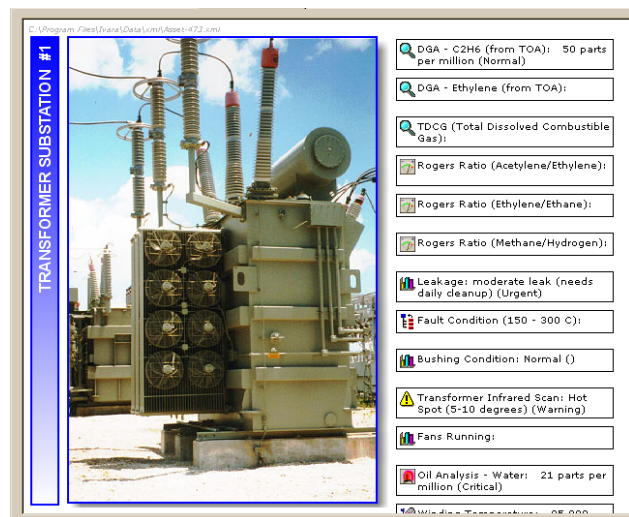


*Trending graph with bands of colour to show alarm severity*

## Graphical Dashboards Provide Visibility to Asset Health

Graphical dashboards allow the monitoring of asset condition and, at a glance, understand if failures are impending. Flashing alarms show when assets are moving closer to functional failure and alarm severities are readily understood based on the type of icon displayed.

Hundreds of condition indicators can be collected for a transformer or any other asset, from a variety of sources, both manual and online. With reliability software, the results of multiple condition indicators are consolidated



*Graphical dashboard provides visual picture of transformer health*

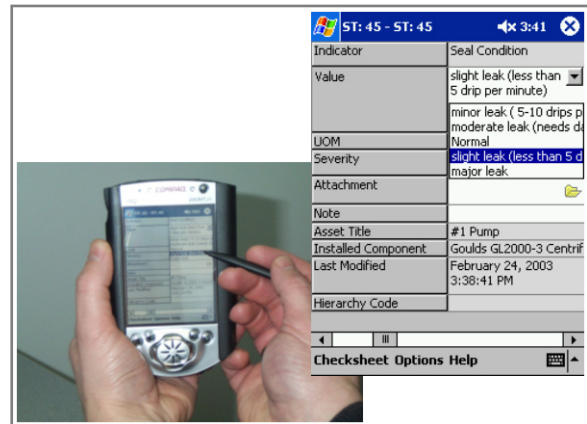
and analyzed to determine potential problems. The right work is automatically generated in the CMMS where a work order is created for the required maintenance action.

### Enabling the Mobile Workforce

In the Transmission and Distribution utilities industry, assets may be spread out over 100,000 square miles and be located in terrain often hard to reach. As such, remote capabilities for handheld devices are an absolute must-have.

With asset reliability software, the remote maintenance worker is fully capable. Using standardized electronic check sheets on handheld devices increases the consistency of data collection, prevents common recording errors and eliminates subjectivity in visual or other human sensory inspections.

Visual tools coupled with a simple, consistent approach make software easier to learn and use, meaning greater acceptance by all types of users.



*Electronic check sheet on handheld provides immediate feedback on asset condition*

### Alarms are not Enough – Determining the Right Work is Key to Success

While many automation tools and data historians provide some basic level of condition data analysis, the difference between these specialized engineering tools and an asset reliability system is the link to the asset maintenance program.

The asset maintenance program is the foundation of a reliability-focused maintenance process. The need to be able to identify the complete maintenance program for each piece of equipment, including all preventive, predictive, detective (failure-finding), and corrective maintenance activities.

The asset maintenance program helps to capture the intellectual knowledge of the people who know the equipment best. Here, that knowledge can be turned into useful information that is easily accessible. With a complete picture of the asset's condition, along with an understanding of best practices (captured in the resulting asset maintenance program), more informed maintenance decisions will be made.

### Best Practices in Work Identification

Without proper work identification, maintenance resources may be wasted and unnecessary or incorrect work will be planned. Once executed, this work may not achieve the desired performance results, despite significant maintenance costs.

Effective and proactive asset maintenance programs can be defined, implemented, and managed with proven work identification methodologies such as RCM or Maintenance Task Analysis. An asset maintenance program consists of pre-planned work. Approximately 90% of

the tasks in a typical proactive maintenance program are inspections, and 73% of those inspections use descriptive indicators. These visual (or other sensory) inspections trigger warning alarms and follow up work tasks to complete more rigorous inspections or corrective work.

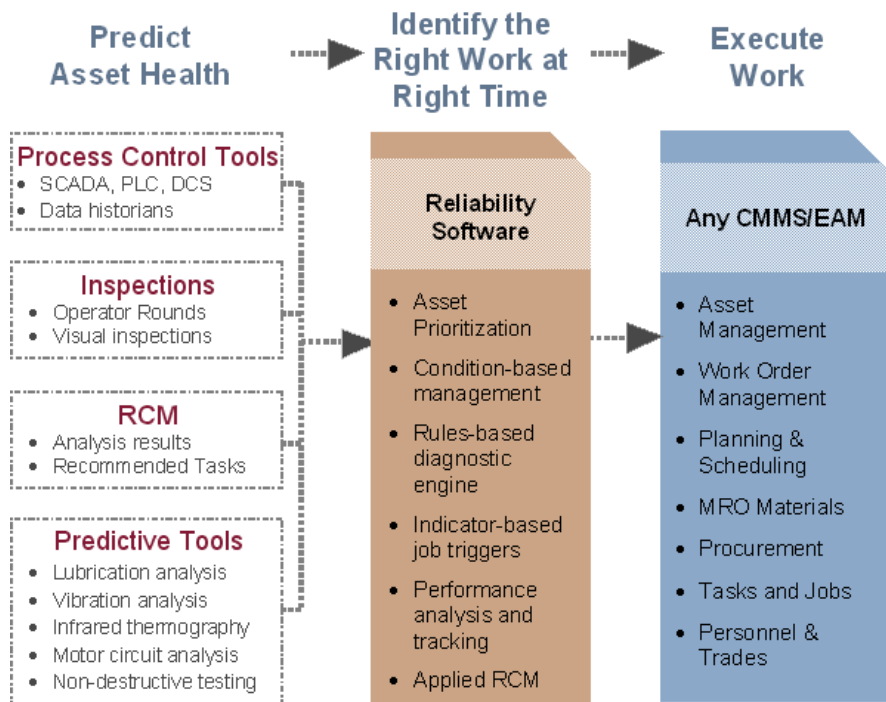
These work identification methodologies help to evaluate current maintenance tasks, remove unnecessary tasks, identify additional tasks, determine optimal task intervals, and define the appropriate condition and state indicators to monitor.

By establishing a complete asset maintenance program and moving to a more proactive, condition and state-based approach, the effectiveness of asset maintenance programs will be optimized – eliminating unnecessary or incorrect work. The frequency of current time-based Preventive Maintenance (PM) tasks will be reduced and the health of equipment will determine when to perform the right work at the right time.

### Integration to Enterprise Asset Management/Computerized Maintenance Management Systems (EAM/CMMS)

Asset reliability software helps companies to leverage and extend the benefits they are getting from current investments in any EAM/CMMS. Maintenance organizations need to incorporate predictive and proactive, condition-based maintenance capabilities upfront to monitor asset conditions and help maintenance personnel keep reliability and productivity on target. Reliability software complements EAM systems to make them more effective because they address upfront the need for work identification and processes not addressed by the EAM.

While EAM/CMMS supports the maintenance control process (work planning, scheduling and execution), reliability software supports the complete equipment reliability process.



## **Where to Start... Prioritizing Assets Based on Risk**

Linking back to a formal asset prioritization, it is possible to systematically identify the assets in the organization most likely to negatively impact business performance if they fail. That is, the assets posing the greatest risk to the business, those that matter most when they fail and that fail too often.

Assets whose failure will most seriously impact business performance result in the highest consequence priority ranking. The consequence priority ranking needs to be used to prioritize maintenance work. If there are three serious alarms to respond to when one starts their day, on which should they start? By prioritizing assets according to business risk, the answer will be obvious.

In addition, the relative risk of the asset, which is calculated by multiplying the probability of failure factor by the total consequence of failure, is used to identify candidates for asset reliability improvement and identifies the projects that should take priority.

## **The Results**

As a result of using an asset reliability strategy, the following benefits will be realized:

- Real-time visibility of equipment health (instead of days or weeks later)
- Substantial decrease in equipment failures due to proactive maintenance
- Improved reporting for regulatory compliance
- Decrease in maintenance costs (i.e. eliminate non-value add maintenance, minimize spare parts inventory)
- Increase CMMS/EAM information accuracy and visibility through an easy-to-use, complimentary technology

Reliability software solves the problem of islands of data by directly linking condition monitoring to EAM/CMMS. Reliability software collects equipment condition data from controls, sensors, data historians, predictive maintenance technologies and visual inspections. Reliability personnel no longer need to remember, or spend time repeating, manual calculations and complex algorithms because the software can perform the calculations and conduct the analysis automatically and then present the results visually as flashing alarms. Using single or multiple data points to analyze the data, the system applies defined rules and calculations to get a true picture of the equipment health. The results are presented visually through flashing alarms and trending graphs, identifying potential failures and recommending corrective actions – before the equipment fails.

Prior to reliability software, maintenance and reliability personnel have had to live with islands of data. Now, reliability software is able to correlate this data into one information system that feeds your EAM/CMMS the right work at the right time to optimize asset performance and extend asset life.

## **Before embarking on a reliability improvement initiative, ensure there is a business case**

Before embarking on an improvement initiative, an organization must have a clear understanding of its performance as it compares to best-in-class standards, as well as the

benefits that can be reasonably anticipated. This is the first stage in developing a reliability strategy. A reliability assessment and business case establish the need, define the metrics, and provide the justification for embarking on a reliability improvement initiative.

A business case for reliability-based maintenance focuses on the impact of improved asset reliability to the organization's bottom line. It answers the questions: What are the likely financial and business benefits of improved asset reliability, what is the cost and effort required to implement a reliability strategy (ie. how are we really going to make this happen) and what are the consequences of not going forward with the initiative (eg. regulatory compliance, safety and environmental integrity, customer retention)?

A reliability-based approach to asset management makes good business sense. However, before embarking on any project, ensure to quantify the financial impact – develop a business case for the solution that fits the company's needs.

## **References**

Ivara Asset Performance Management Software Solution  
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